

### CLAIMS

1. A pierce nut installation apparatus for installing pierce nuts in a panel, said pierce nuts each having a bore therethrough, comprising: a pierce nut installation head having a plunger passage receiving a pierce nut for installation in said panel;

a plunger reciprocating in said plunger passage having a proximal end driving a pierce nut through said plunger passage against a panel opposite said plunger passage piercing a slug from said panel and installing said pierce nut in a pierced opening formed in said panel, said plunger passage having an axial opening telescopically receiving a slug probe rod resiliently biased toward said proximal end of said plunger and extending beyond said proximal end of said plunger through said nut bore if a slug is pierced from said panel and engaging said panel if a slug is not pierced from said panel; and

a sensor sensing axial movement of said slug probe rod to determine whether a slug has been pierced from said panel.

2. The pierce nut installation apparatus as defined in Claim 1, wherein said axial opening in said plunger extends through said plunger and said slug probe rod having an axial length greater than an axial length of said plunger.

3. The pierce nut installation apparatus as defined in Claim 1, wherein said pierce nut installation apparatus includes a die button supporting said panel opposite said plunger passage having an opening receiving said slug and said proximal end of said slug probe rod ejecting said slug through said opening in said die button.

4. The pierce nut installation apparatus as defined in Claim 3, wherein said die button includes a slug sensor detecting receipt of a panel slug pierced from said panel through said opening in said die button.

5. The pierce nut installation apparatus as defined in Claim 4, wherein said slug sensor includes a conductive coil surrounding an opening in said sensor receiving said panel slug and said panel slug creating a magnetic field.

6. The pierce nut installation apparatus as defined in Claim 1, wherein said sensor is a proximity sensor.

7. The pierce nut installation apparatus as defined in Claim 1, wherein said slug probe rod is resiliently biased in said axial opening in said plunger by a coil spring.

8. The pierce nut installation apparatus as defined in Claim 1, wherein said slug probe rod is resiliently biased in said axial opening toward said proximal end of said plunger by pneumatic pressure.

9. A pierce nut installation apparatus for installing pierce nuts in a panel, each pierce nut having a nut bore, comprising: a pierce nut installation head including a pierce nut feed passage, a plunger passage communicating with said feed passage receiving pierce nuts from said feed passage, a plunger reciprocating in said plunger passage having a bore therethrough and a proximal end driving pierce nuts through said plunger passage into a panel opposite said plunger passage and said pierce nut piercing an opening in said panel, a slug probe rod telescopically supported in said bore of said plunger resiliently biased toward said proximal end of said plunger adapted to be received through said nut bore against a panel in the event that an opening is not pierced in said panel, and a sensor sensing axial movement of said slug probe rod to determine whether an opening has been pierced in said panel.

10. The pierce nut installation apparatus as defined in Claim 9, wherein said slug probe rod has an axial length greater than an axial length of said plunger and said slug probe rod having a proximal end adjacent said proximal end of said plunger prior to reciprocal movement of said plunger.

11. The pierce nut installation apparatus as defined in Claim 9, wherein said slug probe rod is spring biased toward said proximal end of said plunger.

12. The pierce nut installation apparatus as defined in Claim 9, wherein said slug probe rod is resiliently biased toward said proximal end of said plunger by pneumatic pressure and said slug probe rod including a return spring biasing said slug probe rod away from said proximal end of said plunger.

13. The pierce nut installation apparatus as defined in Claim 9, wherein said slug probe rod has an enlarged distal end and said sensor detecting movement of said enlarged distal end of said spring probe rod.

14. The pierce nut installation apparatus as defined in Claim 9, wherein said pierce nut installation apparatus includes a die button opposite said plunger passage supporting said panel having an opening coaxially aligned with said plunger passage and a slug sensor detecting receipt of a panel slug pierced from said panel and received through said opening in said die button.

15. The pierce nut installation apparatus as defined in Claim 14, wherein said slug sensor includes a conductive coil surrounding an opening in said sensor receiving said panel slug and said panel slug creating a magnetic field.

16. A pierce nut installation apparatus, comprising: a pierce nut installation head attached to an upper die shoe of a reciprocating die press and a die member attached to a lower die shoe of said reciprocating die press, said pierce nut installation head including a plunger passage receiving a pierce nut having a nut bore therethrough for installation in a panel supported on said die member opposite said plunger passage, a plunger reciprocating through said plunger passage upon closing of said die press having a proximal end driving said pierce nut through said plunger passage, said pierce nut piercing a slug from said panel forming a pierced panel opening in said panel and said die member installing said pierce nut in said panel

opening, said plunger having an axial opening telescopically receiving a slug probe rod having a proximal end portion, said slug probe rod resiliently biased toward said proximal end of said plunger and said proximal end of said slug probe rod extending through said nut bore in the event that a slug is pierced from said panel or engaging said panel in the event that a slug is not pierced from said panel, and a slug probe rod sensor sensing movement of said slug probe rod in said axial opening of said plunger to determine whether an opening has been pierced in said panel connected to a control of said reciprocating die press and stopping said die press in the event that said proximal end of said slug probe rod engages said panel.

17. The pierce nut installation apparatus as defined in Claim 16, wherein said axial opening in said plunger extends through said plunger and said slug probe rod having a distal end extending through a distal end of said plunger and a biasing means resiliently biasing said distal end of said slug probe rod toward said panel.

18. The pierce nut installation apparatus as defined in Claim 17, wherein said biasing means is a spring.

19. The pierce nut installation apparatus as defined in Claim 17, wherein said biasing means is pneumatic pressure.

20. The pierce nut installation apparatus as defined in Claim 16, wherein said die member includes an opening for receiving said slug and a slug sensor sensing receipt of a slug through said opening in said die member connected to said control of said reciprocating die press stopping said reciprocating die press if a slug is not sensed by said slug sensor.

21. A pierce nut installation apparatus for installing pierce nuts in a panel, said pierce nuts having a nut bore therethrough, comprising: a pierce nut installation head including a pierce nut feed passage, a plunger passage communicating with said pierce nut feed passage receiving pierce nuts from said pierce nut feed passage, a

plunger reciprocating in said plunger passage having a proximal end driving pierce nuts through said plunger passage into a panel opposite said plunger passage and said pierce nut piercing a slug from said panel forming a pierced opening through said panel receiving said pierce nut, and a die button opposite said plunger passage supporting said panel having an opening coaxially aligned with said plunger passage and a slug sensor having an opening therethrough coaxially aligned with said opening through said die button detecting receipt of a panel slug pierced from said panel and received through said opening in said sensor.

22. The pierce nut installation apparatus as defined in Claim 21, wherein said sensor includes a conductive coil surrounding said opening through said sensor receiving said panel slug, said conductive coil creating a magnetic field upon receipt of said panel slug.

23. The pierce nut installation apparatus as defined in Claim 21, wherein said plunger includes a bore therethrough and a slug probe rod reciprocally supported in said bore of said plunger resiliently biased toward said proximal end of said plunger adapted to be received through said nut bore against said panel in the event that an opening is not pierced in said panel, and a slug probe rod sensor sensing movement of said slug probe rod to determine whether an opening has been pierced in said panel.

24. The pierce nut installation apparatus as defined in Claim 23, wherein said slug probe rod has an axial length greater than an axial length of said plunger and said slug probe rod having a proximal end adjacent said proximal end of said plunger prior to reciprocal movement of said plunger.

25. A die button for attaching a pierce nut to a panel located in a lower die shoe of a reciprocating press, said pierce nut including a central pilot portion, flange portions on at least opposed sides of said pilot portion and a groove, said die button comprising: a projecting die lip configured to be received in said groove of said

pierce nut, an opening through said die button configured to receive a slug pierced from said panel by said pilot portion of said pierce nut and a slug sensor receiving said slug and sensing receipt of said slug through said sensor and said sensor connected to a control of said reciprocating die press stopping said die press if said slug sensor does not sense a slug received through said sensor.

26. The die button as defined in Claim 25, wherein said slug sensor includes a conductive coil surrounding an opening in said sensor receiving said panel slug and said panel slug creating a magnetic field.

27. The die button as defined in Claim 25, wherein said slug sensor is an infrared sensor.